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Thought suppression failures in combat PTSD: A cognitive load hypothesis☆

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A B S T R A C T

The present study investigated the relation between thought suppression of emotionally neutral content [i.e., Wegner's (1994) "white bear"], incidental traumatic thought intrusion, and skin conductance responses in combat-related Posttraumatic Stress Disorder (PTSD). Participants included service members who either: a) had PTSD following an Operation Iraqi Freedom deployment; b) were free of psychiatric diagnosis following deployment (Combat Equivalent), or c) were pre-deployed and without psychiatric diagnosis (Pre-Deployed). PTSD Service Members reported the greatest intrusion of combat thoughts during the suppression task and demonstrated a post-suppression rebound effect with a neutral thought. Non-specific skin conductance responses indicated that the suppression task was related to similar levels of increased sympathetic activity for both the PTSD and Pre-Deployed groups, whereas the Combat Equivalent group showed no increased activation during thought suppression. Intrusive traumatic thoughts combined with failures in neutral thought suppression may be a consequence of increased cognitive load in PTSD.

Introduction

Intrusive thoughts are an important aspect of Posttraumatic Stress Disorder (PTSD). Horowitz (1986) suggested that traumatic events must be assimilated into the schema of a person's life events. This assimilation process may be inhibited, due to the intense unpleasant arousal of the traumatic event. Assimilation failures are posited to cause "leaks" of traumatic material into consciousness in the form of intrusive thoughts. In accord with recent clinical models of PTSD (Resick & Schnicke, 1992) corrective integration of a traumatic event into the life schema is thought to decrease intrusive thoughts and alleviate PTSD. However, despite its theoretical significance, the cognitive mechanism of thought intrusion has yet to be fully understood.

Information-processing models of thought suppression provide insight into the mechanisms that may underlie intrusive thoughts in PTSD. Wegner's (1994) prototypical "white bear" paradigm requires individuals to observe the frequency of a novel target thought (i.e., the "white bear") during task periods that either allow for ("monitor") or discourage ("suppress") its emphasis (Wegner, Schneider, Carter, & White, 1987). Most individuals are successful in actively suppressing a target thought, yet some experience an increase in target thought frequency once the suppression task has ended (a "rebound" effect during a second monitoring task; Wenzlaff & Wegner, 2000). According to the ironic process theory, thought suppression is supported by two cognitive mechanisms: an effortful search system that seeks to engage in thought content other than the target thought and a non-effortful monitoring system that flags instances when the search system has failed (Wegner, 1992). The non-effortful monitoring system operates with automaticity and may continue when the effortful search system has ended. In this manner, the monitoring system identifies the increase in target thoughts following the suppression task, creating the rebound effect.

Preliminary studies of thought suppression in PTSD indicate rebound-related effects with trauma target thoughts. Increased trauma-related thought rebound has been associated with PTSD following sexual assault (Shipherd & Beck, 1999) and motor vehicle accidents (MVA; Shipherd & Beck, 2005). Additionally, negative mood

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or distress about the intrusive thought was reported in PTSD participants. Similar rebound effects have been reported with PTSD and treatment-seeking traumatized non-PTSD individuals (Beck, Gudmundsdottir, Palyo, Miller, & Grant, 2006) and traumatized college student samples (e.g., Davies & Clark, 1998; Rosenthal, Cheavens, Lynch, & Follette, 2006; Tull, Gratz, Salters, & Roemer, 2004).

Traumatic thought content may directly lead to suppression rebound effects. Alternatively, evidence of rebound effects with non-trauma thoughts may be reflective of PTSD-related deficits in thought suppression ability. In an effort to determine content specificity in PTSD-related rebound effects, MVA survivors were asked to monitor and suppress both trauma and non-trauma neutral personal thoughts (Shipherd & Beck, 2005). Results indicated only a rebound effect with the trauma thought. This finding is consistent with a model of emotional processing which posits that recent exposure to trauma content may prime PTSD individuals to inhibit responses to incongruent emotional content (Litz, Orsillo, Kaloupek, & Weathers, 2000). In this regard, thinking about the trauma in close proximity to a non-trauma suppression task may decrease access to non-trauma thoughts that results in an absence of a rebound effect. Thus, engaging PTSD participants without a discussion of traumatic thought content prior to a neutral thought suppression task would preclude priming to a trauma context. Although a recent investigation of trauma and neutral thought content attempted to examine this issue (Amstadter & Vernon, 2006), its use of a different suppression methodology (i.e. an initial baseline phase that did not introduce the target thought, which is the usual practice with an initial monitoring phase) confounds suppression with cuing effects manifest in the initial monitoring task. As a result, these findings are rendered in comparable to those reviewed above (see Wenzlaff & Wegner, 2000, for review of methodologies). Thus, the scope of thought suppression rebound effects in PTSD populations remains to be clarified.

An additional aspect of thought suppression that has yet to be considered in the PTSD literature is the role of cognitive load on thought suppression failures. Wegner (1992) proposed that suppression failures occur when task demands (increased task complexity) overwhelm the effortful search system. In studies that utilized a variety of manipulations (time constraints, dual tasks), suppression failures were observed in samples of healthy participants (Wegner & Erber, 1992). Thus, at times of high demand, effortful thought suppression –for a neutral target thought- fails due to competition for cognitive resources (Wenzlaff & Wegner, 2000). We hypothesize that PTSD individuals may engage in an ongoing effortful traumatic thought suppression process in a manner similar to that described by Horowitz (1986). This traumatic suppression process would limit the available cognitive resources for PTSD individuals to engage in other concurrent tasks. Thus, it might be expected that PTSD individuals are prone to trauma thought suppression failures during periods of relatively modest cognitive demand, such as a neutral thought suppression task.

Autonomic sympathetic activity should also be concordant with the cognitive effort required to suppress thoughts. For example, Lacey and colleagues (Lacey, Kagan, Lacey, & Moss, 1963) found increased Skin Conductance Level during a variety of tasks. In a similar manner, non-specific Skin Conductance Responses (NS-SCR), spontaneous skin conductance responses observed over some discrete period of time, have been found to increase in frequency during completion of complex tasks (Munro, Dawson, Schell, & Sakai, 1987). Increases in NS-SCR frequency has been conceptualized as an indicator of heightened autonomic activation that is associated with an effortful allocation of attentional resources (Jennings, 1986). Yet, psycho-physiological monitoring has only been included in one study of PTSD thought suppression (Beck et al., 2006), which used heart rate, skin conductance level, and frontalis EMG as measures of autonomic arousal in response to traumatic thoughts. Only minimal group differences in these measures were found, such that the PTSD group had elevated EMG during the suppression task relative to the control group. The authors conceptualized their use of the physiological measures as indices of hyper arousal associated with processing traumatic thought content. In this manner, they speculated that the lack of physiological differences between PTSD and non-PTSD groups was possibly related to the shared degree of distress over their trauma and treatment-seeking status, regardless of PTSD diagnosis. Interestingly, there were no reported task-related physiological effects, despite the fact that both groups demonstrated a thought rebound effect. To date, the use of NS-SCR as a measure of autonomic arousal associated with task effort has yet to be utilized in a thought suppression paradigm. Thus, to the extent that thought suppression is an effortful strategy, concomitant increases in NS-SCR should be found during the suppression task.

To our knowledge, the present paper is the first to investigate thought suppression effects in individuals with combat-related PTSD. The specificity of a suppression-related rebound effect was tested with a standard neutral thought task ("the white bear"). Evidence of a rebound effect with a standard neutral thought would further support the conceptualization of a dysregulated thought suppression mechanism in PTSD. Mood and emotional responses to the thought tasks were recorded in an effort to relate these factors as potential covariates to suppression ability. Second, we wanted to explore the consequence of neutral thought suppression to the ongoing frequency of trauma thought intrusions. As suggested above, the added effort to suppress a novel, affectively neutral thought is predicted to deplete the already tapped cognitive resources in PTSD individuals and result in an increase of incidental intrusive trauma thoughts during the suppression task. Finally, we expected to see an increase in NS-SCR activity during the suppression task relative to the monitoring conditions, as an indicator of increased autonomic activation associated with increased cognitive effort. To the extent that PTSD Service Members are engaged in a dual suppression task (both trauma and white bear thoughts) and thus requiring more cognitive resources than non-PTSD groups, they should show greatest NS-SCR activity.

Methods

Participants

The participants were 43 right-handed active-duty male Service Members, between the ages of 19 and 37, based at Fort Drum, New York. All were members of the 10th Mountain Light Infantry Division (LI). Members of this LI Division were among the first troops deployed in Operation Iraqi Freedom (see Table 1 for demographics and diagnostic data). For those participants who served in Iraq, the average length of time back from Iraq following their first 12-month deployment was 8 months ($SD = 5.3$).

Participants were comprised of three groups: 14 who were combat-exposed during deployment to Iraq and subsequently developed PTSD (PTSD group); 14 who were combat-exposed during the Iraq deployment and did not meet criteria for current diagnosis of PTSD or any other Axis I diagnosis (Combat Equivalent group); and 15 who were yet to be deployed to Iraq, not combat-exposed, and did not have a current Axis I diagnosis (Pre-Deployed group). All participants were free from medical complications and were not taking any prescription or over-the-counter medications.

All PTSD participants met criteria for current PTSD via the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995). The control participants did not meet criteria for current Axis I or Axis II disorders as determined by the Structured Clinical Interview for

Table 1
Demographic summary for combat PTSD, combat equivalent, and Pre-Deployed participants.

	Participant group		
	Combat PTSD ($n=14$)	Combat equivalent ($n=14$)	Pre-deployed ($n=15$)
Age	24.29 (2.55)	24.14 (2.80)	25.47 (5.85)
Years of Education	12.43 (0.76)	12.64 (1.01)	12.80 (1.21)
Years in the Service	4.28 (2.69)	4.98 (2.39)	4.86 (4.24)
Ethnicity			
Caucasian	8 (57.1%)	8 (57.1%)	8 (53.3%)
African-American	1 (7.1%)	2 (14.3%)	5 (33.3%)
Hispanic/Latino	4 (28.6%)	2 (14.3%)	2 (13.3%)
Asian-American	1 (7.1%)	2 (14.3%)	0 (0.0%)

Age, education, and years in service, multivariate $F(6, 76)=0.47$, n.s.

DSM-IV Axis I (SCID-P; First, Spitzer, Gibbon, & Williams, 1995) and the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1995). Four trained clinical psychologists administered the SCID and CAPS assessments. These psychologists had extensive experience in assessing anxiety disorders (including PTSD) and completed an assessment training program at the National Center for PTSD Clinical Neurosciences Division prior to the start of this study. In cases where diagnosticians disagreed, the diagnoses of record were based upon team consensus.

Participants were recruited from Fort Drum via media advertisements, informational flyers, and announcements made during Battalion meetings looking for combat-deployed or pre-deployed research volunteers. During a pre-screening phone interview, participants were excluded if they had any medical conditions that would affect the neuroimaging procedures included as an aspect of the larger investigation, were taking any over-the-counter or prescription medications, experienced clinically significant psychotic symptoms as defined by DSM-IV, had current substance abuse or dependence, or had any organic mental disorders. Out of 71 phone interviews, we excluded 14 (20%) individuals for MR-compatibility reasons (handedness, claustrophobia, medical metal implants, shrapnel, or dental implants), and 9 (13%) for current (including psychiatric) medication use. The 43 participants were selected from the remaining pool of 50 potential participants based on availability. Furthermore, all participants were forewarned that they would be excluded from the study if they were found to be actively using alcohol or illicit drugs as determined by urine drug screen or breathalyzer test administered during the data collection. No participant failed the drug and alcohol screens during the study days.

Overall procedure

Informed Consent was obtained upon arrival of the participants to the Institute of Living at Hartford Hospital. Each individual participated in a larger study involving 2 weekend days of testing, divided into ten 90-minute sessions that were randomized in a Latin-square design such that each session had an equal chance of occurring at each time of the day. Other sessions included functional and structural neuroimaging, and diagnostic and assessment interviews. The current study is reporting on a thought suppression session and the results of the psychological diagnostic interview sessions.

Materials

The following clinician administered diagnostic scales and self-report metrics were administered to each participant.

Clinician Administered PTSD Scale (CAPS)

The CAPS is a structured clinical interview measuring the frequency and intensity of the 17 DSM-IV symptoms of PTSD and the 8 associated symptoms. The CAPS also contains five global rating questions regarding the impact of symptoms on social and occupational functioning, improvement since previous assessment, and overall validity and severity of reported symptoms. The CAPS has an excellent test-retest reliability (.90–.98) and internal consistency (.94). Total severity score on the CAPS has been strongly correlated with the Mississippi Scale for PTSD (.91) and the PK scale of the MMPI-2 (.77). In the validated sample, CAPS total severity scores $\geq$65 had adequate sensitivity (.84), specificity (.95), and efficiency (.89) against PTSD diagnosis based on the Structured Clinical Interview for DSM-IV (SCID) (Blake et al., 1995).

Structured Clinical Interview for DSM-IV (SCID-P)

The SCID (First et al., 1995) was used to assess comorbid diagnostic status for all participants. The SCID is a widely used instrument with acceptable psychometric properties.

Combat exposure scale

Participants completed the Combat Exposure Scale (CES-D; Keane et al., 1989), a 7-item questionnaire based on Vietnam-related combat that measures the intensity, frequency, and duration of exposure to combat-related experiences involving danger, injury, or death. Published reports indicate that the measure has internal stability, test-retest reliability across a 1-week period, construct and cross-cultural validity (Askari, 2005; Keane et al., 1989).

Beck Depression Inventory (BDI)

The BDI (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) is a 21-item self-report measure of severity of depression that has high reliability and validity (Beck, Steer, & Carbin, 1988).

Semantic differential

At the beginning of the thought suppression session, participants were briefly trained to complete a semantic differential mood rating scale (see Osgood, Suci, & Tannenbaum, 1957) in which 15 pairs of contrasting mood adjectives are located at either end of a vertical line and participants are asked to draw a mark corresponding to where their mood state falls in relation to the two words. Items are constructed to reflect two principle mood factors, valence (i.e., *happy—sad, glad—angry, positive—negative*) and arousal (i.e, *peaceful—agitated, relaxed—anxious, calm—tense*). Responses to items are totaled for the valence and arousal factors. Interpretation of the factor scores is that a value of 0 reflects neutrality. Negative scores reflect high arousal or negative valence. Positive scores reflect low arousal or positive valence.

Thought Description Questionnaire (TDQ)

The TDQ (Tolin, Abramowitz, Przeworski, & Foa, 2002) consists of 5 items that ask about occurrences of the target thought during the most recent 5-min period: (1) frequency of the thoughts (response was a number); (2) time spent having the thought (response was a percentage from 0 to 100); (3) pleasantness of the thought (rated on a seven-point scale from 1, extremely pleasant, to 7, extremely unpleasant); (4) vividness of the thought (rated on a seven-point scale from 1, not at all vivid, to 7, extremely vivid); and (5) efforts to suppress the thought (rated on a seven-point scale from 1, no effort, to 7, extremely strong effort).

Apparatus

Thought monitoring was recorded via a tape recorder placed on a table in front of the participant. Each participant recorded the number of thoughts about a white bear with an event key marker (Tally I Hand Model Tally Counter, ACCO Brands, Booneville, MS). Skin Conductance Response was recorded with two Ag-AgCl electrodes filled with an isotonic gel with 0.5% saline in a neutral base (GEL101, BIOPAC Systems, Inc.) were attached via adhesive collars to the medial phalanx of the palmar surface of the first two fingers of the non-dominant hand. Signals were processed with BIOPAC MP150 system attached to a PC laptop and sampled at 1 kHz. Non-specific Skin Conductance Responses (NS-SCR) were defined as events that were 0.05 microsiemens or larger (Andreassi, 2000) and constrained within a 3 second latency window of both task onset and a prior occurrence of a NS-SCR. All responses were analyzed offline.

Procedure

Participants were seated in front of a table with the tape recorder and psycho-physiological recording apparatus, in a small, sound-attenuated room. The experiment consisted of a 5-min baseline of non-activity, a 3-min thought monitoring practice period, and three 5-min trials: *monitor 1*, *suppression*, and *monitor 2 (rebound)*. In order to minimize reactivity, the experimenter left the room during each trial. During each trial, frequency of thoughts about a 'white bear' was collected via event-marking to indicate the occurrence of the target thought and an audio tape recorder, which recorded the verbal thought monitoring task.

Baseline

After applying the skin conductance electrodes, the experimenter informed the participant to sit quietly with his eyes open for five minutes, after which the task would begin. Following the baseline, participants completed the semantic differential.

Practice trial

Each participant received the following verbal instructions: "During this study you will be asked to monitor your thoughts out loud. Whatever thoughts you have are fine. Don't censor yourself or worry about what thoughts you have or don't have. Just notice them and let them pass. With every different thought you have, press the event key. First, you will have a brief trial so that you can practice monitoring your thoughts." Participants practiced monitoring their thoughts for 3 min. The experimenter verified participants' compliance via event key markers; additional practice trials were used when necessary for the participant to understand the task.

Trial 1 (monitor 1)

Next, participants were given instructions in the same manner as the practice session: "Just like before, you will monitor out loud everything that comes to mind. During this time, you may think about anything that you like. For example, you may think about a white bear, but you don't have to. What you think about is up to you. However, if you do happen to think about a white bear, please press the event key." The participants were left alone for 5 min. After Trial 1, the participants reported their degree of suppression effort, the amount of time spent thinking about the target thought, and the valence and vividness of the thought on the TDQ. The experimenter recorded the number on the event key marker on the TDQ and reset the value to zero.

Trial 2 (suppression)

The participants were then given the following instructions: "In the next five minutes, please monitor your thoughts as you did before, with one exception. This time, try NOT to think of a white bear. Every time you think 'white bear' or have a white bear come to mind, though, please press the event key." The participants were left alone for 5 min. After Trial 2, the participants again reported their mental activity on the TDQ. The experimenter recorded the number on the event key marker on the TDQ and reset the value to zero.

Trial 3 (monitor 2)

The participants were then given the following instructions: "Just like before, you will monitor out loud everything that comes to mind. During this time, you may think about anything that you like. For example, you may think about a white bear, but you don't have to. What you think about is up to you. However, if you do happen to think about a white bear, please press the event key." The participants were left alone for 5 min. After Trial 3, the participants completed the same questionnaires. The experimenter recorded the number on the event key marker.

Following Trial 3, the experimenter gave the participant a final version of the TDQ that asked the participant to rate intrusive thoughts about combat in Iraq during each trial of the experiment.

Data reduction

Following data collection, the audio tapes of the thought monitoring tasks were transcribed. In a manner similar to other PTSD thought suppression studies, all thoughts were coded as either OIF combat-related, white bear-related, or "other" (see Shipherd & Beck, 2005). Thought listing data were coded by two trained independent raters. Raters were uninformed of the diagnostic status of the participants and met training criteria by reaching 80% agreement on five consecutive practice cases (Clark, Ball, & Pape, 1991). A total of 92% agreement was reached on thought listing data with the remaining discrepancies (8%) resolved by a third trained rater. Individual variability in the number of thoughts listed across participants was controlled by calculating the percentage of OIF- and white bear-related thoughts for each participant for each phase.

Results

Demographics

A multivariate analysis of variance (MANOVA) revealed no significant group differences in age, education, and years of military service (see Table 1). There were no significant differences between the groups on age and education, with the mean age across the groups ranging from 24.14 to 25.47 years of age and the mean years of education ranging from 12.43 to 12.80. The groups were also similar with regard to ethnicity (see Table 1), with a little more than half of the participants in all three groups composed of Caucasian men, consistent with the demographics of the Army. Additionally, chi-square analyses indicated there were no group differences in ethnicity.

Clinical demographics

PTSD symptom severity

Table 2 highlights group self-report profiles. All combat-exposed participants met A1 and A2 criterion for an event during OIF deployment. By design, a MANOVA indicated significant symptom differences reported among the PTSD, Combat Equivalent, and Pre-Deployed groups [F (10, 70) = 41.56, $p < 0.0001$, $p = 0.86$]. Univariate ANOVAs indicated group differences in combat exposure, depressive symptoms, and total symptoms of traumatic stress [CES, F (2, 40) = 167.37, $p < 0.0001$, $p = 0.89$; BDI, F (2, 40) = 12.99, $p < 0.0001$, $p = 0.39$; CAPS total score, F (2,

Table 2
Clinical summary for combat PTSD, combat equivalent, and Pre-Deployed participants.

	Participant group		
	Combat PTSD ($n = 14$)	Combat equivalent ($n = 14$)	Pre-deployed ($n = 15$)
CAPS total	65.79 (17.80)[a]	17.07 (17.08)[b]	1.73 (2.94)[c]
CAPS B	18.71 (6.13)[a]	5.00 (5.91)[b]	0.33 (0.90)[c]
CAPS C	23.71 (9.14)[a]	3.71 (5.31)[b]	0.67 (1.80)[b]
CAPS D	23.36 (5.42)[a]	8.36 (8.28)[b]	0.73 (2.02)[c]
Distress	2.14 (0.86)[a]	0.14 (0.36)[b]	
Social Impairment	1.86 (0.95)[a]	0.14 (0.53)[b]	
Occupational Impairment	0.93 (0.92)[a]	0.00 (0.00)[b]	
CES	30.14 (6.53)[a]	26.71 (5.46)[a]	0.00 (0.00)[b]
BDI	11.57 (7.78)[a]	3.21 (3.45)[b]	2.40 (3.64)[b]

CAPS (Clinician Administered PTSD Scale); CES (Combat Exposure Scale); BDI (Beck Depression Inventory); Different superscripts indicate significant differences at $p < 0.05$.

40) = 79.69, $p < 0.0001$, $p = 0.80$].[1] Post-hoc analyses (with Bonferroni adjustment $p < 0.05$) indicated increased BDI scores in the PTSD group relative to both the Combat Equivalent and Pre-Deployed groups.[2] Similar post-hoc analyses indicated differences in combat exposure only between Pre-Deployed and the two deployed groups. Univariate ANOVAs for each respective cluster resulted in significant group differences for *re-experiencing* (Cluster B), F (2, 40) = 54.78, $p < 0.0001$, $p = 0.73$, *avoidance and numbing* (Cluster C), F (2, 40) = 59.54, $p < 0.0001$, $p = 0.75$, and *hyper arousal* (Cluster D), F (2, 40) = 57.31, $p < 0.0001$, $p = 0.74$. Post-hoc analyses of each cluster indicated that the PTSD group had significantly more severe CAPS symptoms than the Combat Equivalent and Pre-Deployed groups. More symptoms were reported in the Combat Equivalent than the Pre-Deployed group for Cluster B and D.

An additional analysis was conducted on the CAPS data for Criteria F (Distress, social impairment, and occupational impairment) between PTSD and Combat Equivalent groups. A 2 (Group) × 3 (Criteria) MANOVA indicated a main effect for Group, F (3, 24) = 19.85, $p < 0.0001$, $p = 0.71$. The PTSD group had higher scores than the Combat Equivalent group on measures of distress [F (1, 28) = 63.70, $p < 0.0001$, $p = 0.71$], social impairment [F (1, 28) = 34.67, $p < 0.0001$, $p = 0.57$], and occupational impairment [F (1, 28) = 14.36, $p < 0.001$, $p = 0.36$].

Diagnostic interviews

Only two of the Service Members in the PTSD group met criteria for a comorbid Axis I diagnosis (Dysthymic Disorder) that existed prior to deployment, and none of the Service Members met criteria for current substance abuse or dependence. Thirty-five percent of the sample ($n = 15$) was randomly selected for an independent rater to listen to the audio taped interviews and establish inter-rater reliability of diagnoses. The kappa coefficient for PTSD diagnosis was .93.

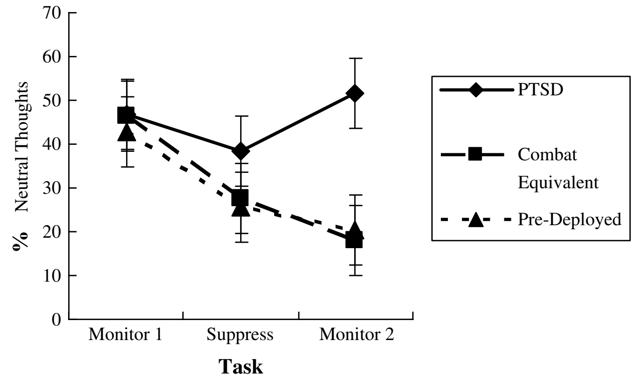

Fig. 1. Evidence of a rebound effect for a standard neutral thought in PTSD service members. Percentage of neutral thoughts significantly increases only in the PTSD group during the monitor 2 condition. Error bars indicate SEM.

Intrusive thoughts

White bear thoughts[3]

In a test of the first hypothesis, the percentage of white bear thoughts was entered into a 3 (Group) × 3 (Thought Condition) mixed factor ANOVA, with thought condition as the repeated measure. As seen in Fig. 1, a significant main effect for Thought Condition, F (2, 39) = 4.63, $p < 0.02$, $p = 0.19$, was modified by a Group × Condition interaction, F (2, 40) = 3.76, $p < 0.03$, $p = 0.16$. For all participants, there was a significant reduction in the frequency of white bear thoughts between the Monitor 1 and Suppression conditions, F (1, 40) = 6.44, $p < 0.02$, $p = 0.14$. Frequency of white bear thoughts remained unchanged from the Suppression to the Monitor 2 condition for the Pre-Deployed and Combat Equivalent Groups, F (1, 27) = 6.83, $p < 0.02$, $p = .20$, but was at a frequency that was still lower than the Monitor 1 condition, F (1, 27) = 16.95, $p < 0.0001$, $p = 0.39$. In contrast, PTSD participants reported a significant increase in the percentage of white bear thoughts from the Suppression to Monitor 2 condition, F (1, 13) = 7.21, $p < 0.01$, $p = .55$. The percentage of white bear thoughts during the Monitor 2 condition was significantly greater for the PTSD group ($M = 51.8\%$, $SE = 3.0$), than for the Combat Equivalent ($M = 18.1\%$, $SE = 3.0$) or the Pre-Deployed groups ($M = 20.3\%$, $SE = 3.0\%$), F (2, 40) = 4.98, $p < 0.012$, $p = 0.20$.

Baseline self-reported arousal and valence ratings did not differ across the three groups, F (4, 80) = 2.16, n.s. On the TDQ, PTSD participants rated the white bear thoughts as more *vivid* than did the Combat Equivalent and Pre-Deployed participants, F (2, 40) = 3.08, $p < 0.05$, $p = 0.13$, (Bonferroni post-hoc adjustments significant at alpha < 0.05). There were no group differences in reported pleasantness or suppression effort. Baseline arousal and valence ratings and TDQ scores were also assessed as potential covariates with thought intrusion across groups. These measures had no significant effects on the thought intrusion results.

Iraq combat thoughts

In a test of our second hypothesis, percentage of intrusive combat trauma thoughts found in PTSD and Combat Equivalent groups were analyzed utilizing a 2 (Deployed Group) × 3 (Thought Condition) mixed factor ANOVA, with thought condition as the

[1] All effect sizes were calculated using partial eta squared, the ratio of variance accounted for by the independent variable over the sum of the variance accounted for by the independent variable and the variance attributed to error.

[2] BDI scores for the two PTSD Service Members diagnosed with Dysthymic Disorder were 28 and 24, respectively. The mean PTSD BDI score with these two participants excluded was 8.09 (3.75), with a PTSD group maximum score of 13. There were no changes in the tests of our hypotheses when these participants were removed. The reported results include the two dysthymic PTSD participants.

[3] Analyses were similar with both the percentage frequency and event key thought monitoring methods. The percentage data are reported to provide comparisons to past PTSD studies. Further, analysis of absolute scores did not yield different results.

repeated measure. As seen in Fig. 2, a significant main effect for Deployed Group, $F(1, 26) = 5.19$, $p < 0.03$, $p = 0.17$, was modified by a Deployed Group × Condition interaction, $F(2, 25) = 4.10$, $p < 0.02$, $p = 0.14$. When divided into the three task conditions, there was only a significant difference in number of intrusive combat thoughts in the Suppression condition between the PTSD and Combat Equivalent groups, $t\ (26) = 2.90$, $p < 0.008$. Additionally, within-subjects contrasts indicated that although frequency of combat thoughts remained the same between the two thought monitor conditions for the PTSD participants, $F\ (1,13) = 2.33$, n.s., there was a significant increase in the frequency of intrusive combat thoughts between the Monitor and Suppression conditions, $F(1, 13) = 4.87$, $p < 0.05$. No other comparisons were significant.

As per report on the TDQ, the PTSD Service Members rated Iraq related combat thoughts as more *vivid*, $t\ (26) = 3.24$, $p < 0.003$, and reported more effort to suppress them, $t\ (26) = 2.48$, $p < 0.02$, than the Combat Equivalent group. There were no deployed group differences in the *pleasantness* of the trauma thoughts, $t\ (26) = 1.46$, n.s.

Psychophysiology

Skin conductance response

An initial Univariate ANOVA indicated no differences in NS-SCR frequency at baseline between the three groups, Univariate $F\ (2, 40) = 0.43$, n.s., $p = 0.02$. In a test of our third hypothesis, a significant multivariate main effect for Thought Condition, $F\ (3, 38) = 81.29$, $p < 0.0001$, $p = 0.87$, was modified by a Group × Condition interaction, $F\ (6, 78) = 3.17$, $p < 0.008$, $p = 0.20$ (See Fig. 3). All groups showed a significant increase in NS-SCR frequency from baseline to the thought tasks, all within contrasts significant at $p < 0.0001$. There were no significant differences in NS-SCR frequency between PTSD and Pre-Deployed groups. In considering the combination of PTSD and Pre-Deployed groups, the number of NS-SCRs significantly increased from the Monitor 1 to Suppression condition, $F(1, 27) = 7.54$, $p < 0.01$, $p = 0.22$, and then decreased from the Suppression to Monitor 2 conditions, $F\ (1,27) = 13.41$, $p < 0.001$, $p = 0.33$. There was no significant difference between NS-SCRs during the Monitor 1 and Monitor 2 conditions, $F(1, 27) = 0.33$, n.s., $p = 0.01$. In contrast, NS-SCRs in the Combat Equivalent group remained unchanged throughout the 3 task conditions, $F(2, 12) = 0.32$, n.s., $p = 0.05$. The Combat Equivalent group had fewer NS-SCRs during the Suppression condition relative to both Pre-Deployed and PTSD groups, $F\ (2, 40) = 7.33$, $p < 0.002$, $p = 0.27$, all Bonferroni-corrected post-hoc comparisons significant at alpha = 0.05.

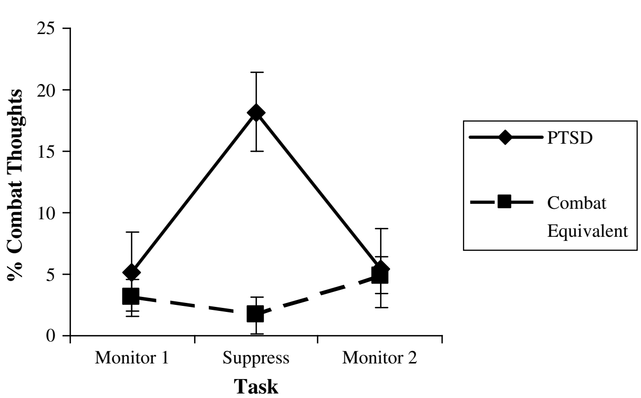

Fig. 2. Relative to non-PTSD combat equivalent exposed participants, PTSD individuals report a significant increase in trauma thoughts during a neutral thought suppression task. Error bars indicate SEM.

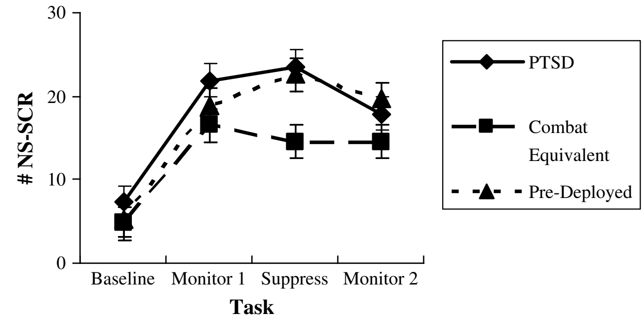

Fig. 3. Non-specific skin conductance responses increase during cognitive activity. An additional increase in responses is indicated in PTSD and Pre-Deployed service members. Error bars indicate SEM.

Discussion

Thought intrusion is a critical component of the PTSD diagnosis. Yet, the information-processing mechanism of intrusive thoughts remains to be fully explicated. In the PTSD literature, aberrations in thought suppression may be specific to trauma content, or broadly related to the suppression process itself. In the present study, we found support for the latter: PTSD Service Members demonstrated post-suppression rebound with a neutral “white bear” target thought, whereas both non-PTSD Combat Equivalent and Pre-Deployed Service Members did not. Further, we tested a cognitive load hypothesis, suggesting that traumatic thought intrusions for individuals with PTSD occur at times of relatively high cognitive demand, such as a thought suppression task. We hypothesized that PTSD Service Members engage in an on-going process of suppressing unwanted combat-related thoughts, a partial reflection of the lack of integration of this material into their personal schemas (Horowitz, 1986). In this manner, directions to suppress a neutral thought (the “white bear”) would be most likely to cause a failure in traumatic thought suppression. In support of this hypothesis, PTSD Service Members reported an increase in traumatic thoughts during the suppression task, whereas Combat Equivalent Service Members did not. Finally, we hypothesized that the cognitive demand of the neutral thought suppression task would be associated with increased ANS reactivity as measured by an increased NS-SCR frequency. Results revealed that all Service Members demonstrated an NS-SCR increase from resting baseline to the thought tasks. However, PTSD and Pre-Deployed Service Members demonstrated an additional NS-SCR increase during the suppression task, whereas, Combat Equivalent Service Members showed no additional NS-SCR activity during thought suppression.

Our findings both support and extend the literature in several ways. In a manner similar to studies of civilian samples using trauma-specific thoughts, our PTSD Service Members demonstrated a rebound effect with a standard neutral thought. In contrast to past studies, this rebound effect was found in the absence of any reported negative mood or valence changes during the task. This evidence lends support to a conceptualization of a more general PTSD-related information-processing anomaly that may underlie difficulties with suppressing trauma-specific content.

The current findings are in contrast to past work that failed to find evidence of post-suppression rebound effects with neutral thoughts. Shipherd and Beck (2005) investigated both traumatic and neutral thought suppression performance during the same laboratory session. The flooding effects of trauma content on later information-processing abilities has long been discussed in the PTSD literature, particularly with regard to the trauma-specific order effects for modified Stroop tasks (see McNally, Kaspi, Riemann, & Zeitlin, 1990). In this regard, it is possible that both the anticipation and facilitation of trauma-specific thoughts in that study had an effect on subsequent tasks such that neutral thoughts were not actively suppressed. In the present study, rebound effects with a neutral thought were found when no mention of trauma was made by the experimenter prior to or during the thought tasks, so as to not facilitate focus on trauma. As such, future investigations will need to make the distinction between individuals who suppress a neutral thought with and without an additional explicit trauma thought monitoring task.

An additional component of this study was examination of the differential effects of cognitive demands on the three groups. We hypothesized that cognitive load would contribute to performance decrements in the PTSD participants. It has been shown that manipulating task demands significantly affects thought suppression failures, such that increased task complexity gives rise to intrusive thoughts (Wenzlaff & Wegner, 2000). In the present study, we considered the neutral thought suppression task as relatively high cognitive load, predicated on the notion that PTSD Service Members engage in an on-going suppression of trauma-related content. Wegner (1994) broadly conceptualized cognitive load as multitasking, such that additional working memory tasks would be hypothesized to disrupt suppression. As such, intrusive traumatic thoughts may be evidenced during other demanding (yet non-trauma related) information-processing tasks or neuropsychological assessments. In this manner, our finding supports a conceptualization of PTSD in which general cognitive processing ability is negatively affected by the on-going task demands of processing traumatic thoughts.

This was the first study to use NS-SCR frequency as a measure of autonomic activation that would correspond with cognitive load in a thought suppression paradigm. Past research indicated NS-SCR increases during conditions associated with greater cognitive complexity (Munro, Dawson, Schell, & Sakai, 1987). Consistent with this work, all groups showed an NS-SCR frequency increase relative to resting baseline. Further, both PTSD and non-PTSD Pre-Deployed Service Members demonstrated an additional NS-SCR increase during the suppression task. Yet, these NS-SCR increases were found in the absence of similar increases in self-rated suppression effort. We had expected PTSD participants would be more cognitively active during the suppression task, as they were hypothetically engaged in dual suppression tasks (i.e., spontaneous suppression of trauma content and directed suppression of neutral content). Instead, the Combat Equivalent group showed a unique NS-SCR pattern that did not differentiate the three tasks (i.e., monitor, suppress, post-suppression monitor). It may be the case that the NS-SCRs of the PTSD and Pre-Deployed groups are reflective of a normative response pattern to the thought suppression task.

The present study's incorporation of combat equivalent Service Members without psychiatric diagnoses allows for a consideration of the individual differences that may contribute to resilience (Masten, 2001; Southwick, Vythilingam, & Charney, 2005). In an extrapolation of Horowtiz's (1986) model with the present data, we propose that the Combat Equivalent Service Members more successfully integrated the traumatic combat experience into their personal schemas than those with PTSD. As a result, the Combat Equivalent group did not have to allocate cognitive resources towards on-going traumatic thought suppression. For these participants, the laboratory suppression task is not considered an instance of high cognitive load, thus no significant increases in trauma-related thoughts would be expected. In this manner, the Combat Equivalent group was able to successfully suppress the white bear thought without requiring additional sympathetic engagement, as measured by NS-SCR. As these participants were exposed to the same combat trauma, were diagnosis-free, and most importantly, reported no impairments from their trauma exposure, it raises the possibility that they represent a select group who are combat resilient.

In the execution of this study, several possible limitations were considered: 1) whereas the PTSD symptom severity of our sample is similar with that of the previous thought suppression PTSD data, the duration of illness is far more acute. It may be possible that additional thought suppression and mood effects are related to chronic PTSD illness. 2) Our sample consisted entirely of men, thereby preventing the investigation of potential relevant gender effects. 3) Further, our study did not include a group that only monitored through the three tasks. As such, we do not know if the frequency of neutral thoughts would increase without the suppression instructions. 4) Also, we utilized the Combat Exposure Scale, which was based on the experiences of Vietnam-era Veterans. Whereas our use of the CES allowed for a comparison of the combat severity in the present work to the majority of other combat-related PTSD research, recent measures, such as the Deployment Risk and Resilience Inventory (King, King, & Vogt, 2003) more accurately reflect the combat events likely deployed in recent desert warfare. Thus, our understanding of the combat stress experienced by the deployed groups in the present study must take this consideration into account. 5) Finally, we do not know if increased mental effort in general or thought suppression per se is related to increased intrusive thoughts.

In summary, findings from the current study have important contributions to our understanding of PTSD as well as trauma resilience. Combat-related PTSD was associated with a greater incidence of combat-related traumatic thoughts during a neutral thought suppression task, followed by a post-suppression rebound effect with a neutral thought. This profile of findings has not been found to date in the PTSD thought suppression literature, and suggests a PTSD information-processing anomaly that is not specific to trauma-related thoughts. Whereas a cognitive load model may partially account for these results, we found no evidence of PTSD-related increased sympathetic activity (measured by NS-SCR frequency) during the thought suppression task. Rather, the Combat Equivalent group successfully suppressed neutral thoughts without any increase in traumatic thought intrusion or NS-SCR increases. The unique performance from the Combat Equivalent group provides preliminary evidence for a cognitive process that may be indicative of resilient responses to traumatic stress. Thus, thought suppression mechanisms may make important contributions to a variety of outcomes following traumatic exposure.

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References

Amstadter, A. B., & Vernon, L. L. (2006). Suppression of neutral and trauma targets: implications for posttraumatic stress disorder. *Journal of Traumatic Stress, 19*, 517–526.

Andreassi, J. L. (2000). *Psychophysiology: Human behavior and physiological response* (4th ed.). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Askari, S. (2005). Psychometric evaluation of combat exposure scale in Iranian war veterans. *Psychological Research, 7*, 58–64.

Beck, A. T., Steer, R. A., & Carbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. *Clinical Psychology Review, 8*, 77–100.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561–571.

Beck, J. G., Gudmundsdottir, B., Palyo, S. A., Miller, L. M., & Grant, D. M. (2006). Rebound effects following deliberate thought suppression: does PTSD make a difference? *Behaviour Therapy, 37*, 170–180.

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., et al. (1995). The development of a clinician-administered scale, PTSD scale. *Journal of Traumatic Stress, 8*, 75–90.

Clark, D. M., Ball, S., & Pape, D. (1991). An experimental investigation of thought suppression. *Behaviour Research and Therapy, 29*, 253–257.

Davies, M. I., & Clark, D. M. (1998). Though suppression produces a rebound effect with analogue post-traumatic intrusions. *Behaviour Research and Therapy, 36*, 571–582.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. (1995). *Structured Clinical Interview for the DSM-IV Axis I disorders-patient edition (SCID-I/P, Version 2.0)*. New York: Biometrics Research Dept., New York State Psychiatric Institute.

Horowitz, M. J. (1986). Stress-response syndromes: a review of posttraumatic and adjustment disorders. *Hospital & Community Psychiatry, 37*, 241–249.

Jennings, J. R. (1986). Bodily changes during attending. In M. G. H. Coles, E. Donchin, & S. W. Porges (Eds.), *Psychophysiology: Systems, processes, and applications* (pp. 268–289). New York: Guilford Press.

Keane, T. M., Fairbank, J. A., Caddell, J. M., Zimering, R. T., Taylor, K. L., & Mora, C. A. (1989). Clinical evaluation of a measure to assess combat exposure. *Psychological Assessment, 1*(1), 53–55.

King, D. W., King, L. A., & Vogt, D. S. (2003). *Manual for the DeploymentRisk and Resilience Inventory (DRRI): A collection of measures for studying deployment – Related experiences of military veterans*. Boston, MA: National Center for PTSD.

Lacey, J. I., Kagan, J., Lacey, B. C., & Moss, H. A. (1963). The visceral level: situational determinants and behavioral correlates of autonomic response patterns. In P. H. Knapp (Ed.), *Expressions of the emotions in man* (pp. 161–196). New York: International Universities Press.

Litz, B. T., Orsillo, S. M., Kaloupek, D., & Weathers, F. (2000). Emotional processing in posttraumatic stress disorder. *Journal of Abnormal Psychology, 109*, 26–39.

McNally, R. J., Kaspi, S. P., Riemann, B. C., & Zeitlin, S. B. (1990). Selective processing of threat cues in posttraumatic stress orders. *Journal of Abnormal Psychology, 99*, 298–402.

Masten, A. S. (2001). Ordinary magic: resilience processes in development. *American Psychologist, 56*, 227–238.

Munro, L. L., Dawson, M. E., Schell, A. M., & Sakai, L. M. (1987). Electrodermal lability and rapid performance decrement in a degraded stimulus continuous performance task. *Journal of Psychophysiology, 1*, 249–257.

Osgood, C., Suci, G., & Tannenbaum, P. (1957). *The measurement of meaning*. Urbana, IL: University of Illinois.

Resick, P. A., & Schnicke, M. K. (1992). Cognitive processing therapy for sexual assault victims. *Journal of Consulting and Clinical Psychology, 60*, 748–756.

Rosenthal, M. Z., Cheavens, J. S., Lynch, T. R., & Follette, V. (2006). Thought suppression mediates the relationship between negative mood and PTSD in sexually assaulted women. *Journal of Traumatic Stress, 19*, 741–745.

Shipherd, J. C., & Beck, J. G. (1999). The effects of suppressing trauma-related thoughts on women with rape-related posttraumatic stress disorder. *Behaviour Research & Therapy, 37*, 99–112.

Shipherd, J. C., & Beck, J. G. (2005). The role of thought suppression in posttraumatic stress disorder. *Behavior Therapy, 36*, 277–287.

Southwick, S. M., Vythilingam, M., & Charney, D. S. (2005). The psychobiology of depression and resilience to stress: implications for prevention and treatment. *Annual Review of Clinical Psychology, 1*, 255–291.

Tolin, D. F., Abramowitz, J. S., Przeworski, A., & Foa, E. B. (2002). Thought suppression in obsessive-compulsive disorder. *Behaviour Research and Therapy, 40*, 1255–1274.

Tull, M. T., Gratz, K. L., Salters, K., & Roemer, L. (2004). The role of experiential avoidance in posttraumatic stress symptoms and symptoms of depression, anxiety, and somatization. *Journal of Nervous and Mental Disease, 192*, 754–761.

Wegner, D. M. (1992). You can't always think what you want: problems in the suppression of unwanted thoughts. *Advances in Experimental Social Psychology, 25*, 193–225.

Wegner, D. M. (1994). *White bears and other unwanted thoughts: Suppression, obsession, and the psychology of the mental control*. New York: Guilford Press.

Wegner, D. M., & Erber, R. (1992). The hyperaccessibility of suppressed thoughts. *Journal of Personality and Social Psychology, 63*, 903–912.

Wegner, D. M., Schneider, D. J., Carter, S. R., & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology, 53*, 5–13.

Wenzlaff, R. M., & Wegner, D. M. (2000). Thought suppression. *Annual Review of Psychology, 51*, 59–91.